UPPER WINDS AT RENO, NEVADA

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A tabulation of pilot-balloon observations at Reno, Nev., during the 3-year period, 1930–32, inclusive, reveals that 98 percent of the possible ascensions have been made for the twice-daily observations at 3 a.m. and 3 p.m., P.S.T. A 77 percent average was obtained at the 4,000-meter level or 2,654 meters above the surface. The 3-year record for the winter season (December, January, and February) shows that 92 percent of the possible observations have been made at 2,000 meters, while 62 percent have been made at 4,000 meters. For the summer season (June, July, and August) the average is 99 percent for 2,000 meters and 89 percent for 4,000 meters.

This rather high percentage has been obtained in spite of the fact that Reno is only 30 miles east of the higher ranges of the Sierra Nevada Mountains, a region noted for stormy periods from October to May. The location is on the leeward side of this mountain barrier during most of the stormy periods, because these storms are usually accompanied by a wind-flow over the mountains from the southwest quarter, and this location has a direct relation to the number of ascensions possible. The wind direction and velocity at the 3,000- and 4,000-meter levels are frequently obtained during stormy weather over the high Sierras, when the ceiling is reported as zero or nearly so at the Donner Summit station which is west-southwest of Reno. In Gregg's Aeronautical Meteorology, page 196, the following statement occurs: "Ceilings are always higher over valleys and lower in the mountains when cyclonic conditions produce cloudiness." This condition is very noticeable in this locality. Not only does the ceiling form a sort of an arch over the valley, especially with a southwesterly wind-flow over the mountains, but large breaks in the cloud canopy over the valley are common. Under such conditions the cloud base to the east usually is higher than to the west, yet it may top the lower ranges east or even obscure them during the more stormy periods. A more nearly level cloud base occurs with a northerly, northeasterly, or easterly wind-flow over the mountains.

On account of the location of Reno the wind direction as recorded from the pilot-balloon observations at the lower levels in the valley (usually below 3,000 meters sea level) often varies considerably from that of the flow over the mountains. In an article in the MONTHLY WEATHER REVIEW, October 1931, volume 59, page 380, Delbert M. Little states: "The return flow near the surface on the leeward side of a mountain barrier has often been noted." This condition is very noticeable at Reno, especially when a southwesterly gale occurs at 3,000 or 4,000 meters. At such a time a northeasterly or easterly wind, occasionally moderate or even fresh, frequently is observed at the surface.

The table showing the percentages of times and average meters per second for the 16 points of the compass and for the surface (1,346), 2,000-, 3,000-, and 4,000-meter levels is taken from the 3 a.m. and p.m., P.S.T. observations for the 3-year period, 1930–32, inclusive. The wind roses are made directly from the data given in this table for seasonal winds. Beginning February 11, 1931, four ascensions have been made daily whenever possible. A table for the 2-year period March 1, 1931–March 1, 1933, shows the average velocity of all directions for each of the four times daily. This is computed for the surface and for the 3,000-meter level. According to this table, the surface winds are consistently highest at 3 p.m., P.S.T., throughout the year, and usually are lowest at 3 a.m. For the 3,000-meter level, the opposite is indicated, with the lowest velocity at 3 p.m. for all months except January. This agrees with observations made over the eastern and central portions of the United States. (Gregg's Aeronautical Meterorology, pp. 90–91.)

Another table shows the percentage of times and average meters per second from each of the 16 points of the compass for the three summer months of 1931 and 1932 at 3 a.m., P.S.T. The table also includes similar data for the same period, when thunderstorms followed within 24 hours. For the levels considered, there seems to be no appreciable difference between the wind direction at 3 a.m. on the days when thunderstorms followed within 24 hours, and the wind direction at this time for all of the days of the two summer seasons. However, there is a difference in the velocity. Although the average velocity of the wind on the surface at 3 a.m. for the two summer seasons is the same as that for the observations preceding thunderstorms, the average velocity preceding thunderstorms gradually falls behind the average velocity for the period as the altitude increases up to 4,000 meters. The average for the 4,000-meter level is 7.2 m.p.s. as compared with 5.2 m.p.s. preceding thunderstorms.

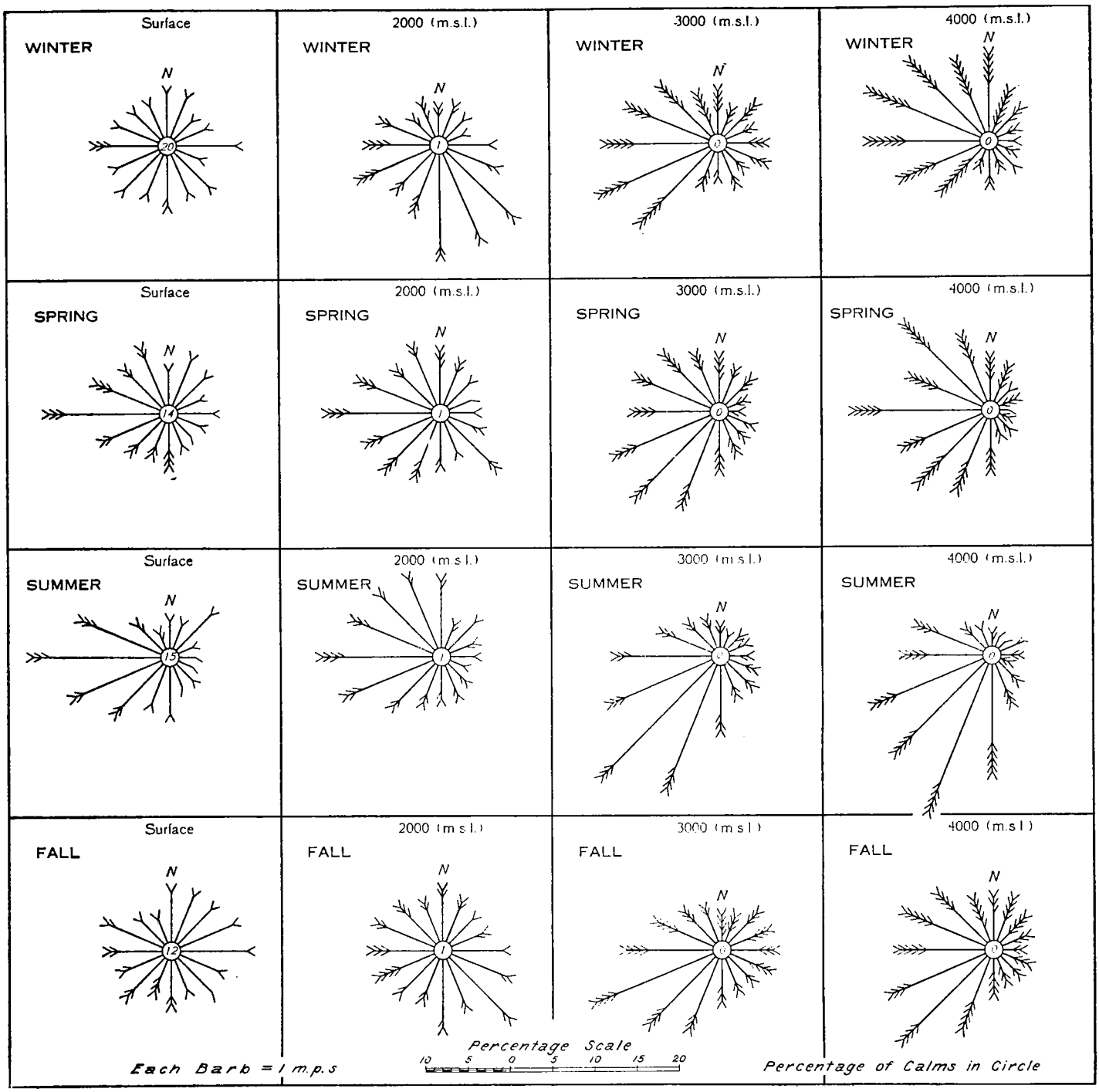
Seasonal winds, Reno, Nev., 1930–32

WINTER

Altitude	N.		NNE.		NE.		ENE.		E.		ESE		SE.		SSE.		S.		SSW.		SW.		WSW.		W.		WNW.		NW.		NNW.		Percent of calms	Percent of possible observations
	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent		
Surface	1.8	5	1.8	5	1.8	3	2.0	4	2.0	7	1.6	3	1.8	6	3.0	5	3.2	6	62.3	5	1.6	6	2.2	5	4.7	7	2.5	5	2.2	4	2.1	4	20	98
2,000 m.s.l.	4.0	3	2.8	4	2.2	3	2.2	2	1.9	5	2.7	6	3.1	11	3.3	11	4.3	12	5.1	7	4.5	6	6.6	9	6.7	7	3.6	6	2.9	3	4.9	4	1	92
3,000 m.s.l.	8.4	5	5.0	3	6.7	5	4.2	3	5.5	4	5.3	5	4.2	3	3.6	4	3.3	3	4.7	4	10.9	12	10.5	14	9.8	12	8.2	10	8.8	8	9.1	5	0	81
4,000 m.s.l.	10.0	9	12.3	5	5.0	4	4.0	2	1.7	2	4.0	2	2.1	3	3.5	2	3.6	4	4.0	2	12.9	7	12.0	10	12.0	13	12.6	14	12.2	12	12.3	9	0	62

SPRING

Surface	1.7	4	2.5	6	2.4	5	1.9	3	2.3	4	1.9	3	1.3	3	2.5	3	5.5	5	4.3	4	3.5	5	4.1	7	5.7	13	5.5	8	3.5	6	3.5	7	14	99
2,000 m.s.l.	5.1	6	3.5	5	1.9	4	1.4	3	2.5	3	2.9	4	3.7	8	2.4	4	3.3	5	4.7	7	5.7	8	6.0	8	6.8	12	5.6	9	4.2	6	3.7	7	1	98
3,000 m.s.l.	6.8	5	3.6	4	4.7	4	4.1	2	3.2	1	2.8	3	4.2	3	4.6	4	7.2	6	7.4	11	7.1	13	7.7	12	8.1	9	6.4	9	7.5	8	5.9	6	0	90
4,000 m.s.l.	7.7	5	7.6	4	2.0	2	6.3	2	0.1	1	3.5	1	2.9	2	3.2	2	8.0	6	8.9	9	10.6	11	8.3	10	10.3	15	10.5	9	11.2	13	9.1	8	0	74



Wind roses, Reno, Nev.

Seasonal winds, Reno, Nev., 1930–32—Continued

SUMMER

Altitude	N.		NNE.		NE.		ENE.		E.		ESE.		SE.		SSE.		S.		SSW.		SW.		WSW.		W.		WNW.		NW.		NNW.		Percent of calms	Percent of possible observations
	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent		
Surface	2.3	3	1.7	3	1.9	6	1.8	2	1.2	2	0.9	2	2.3	3	1.2	3	1.9	6	2.7	5	3.5	8	3.6	11	5.3	15	5.0	10	3.1	4	2.7	2	15	100
2,000 m.s.l.	3.1	8	2.7	3	1.9	5	2.8	3	2.5	3	1.8	2	2.7	3	2.6	4	3.3	4	4.5	5	4.1	7	5.3	11	7.0	13	4.9	10	3.8	9	3.1	9	1	99
3,000 m.s.l.	4.0	2	1.6	1	3.4	2	3.4	2	2.8	2	3.8	3	3.9	4	4.5	4	5.2	8	7.4	16	6.3	19	6.4	13	5.1	11	4.6	6	4.2	4	4.1	3	0	98
4,000 m.s.l.	3.2	1	0.7	1	1.3	1	4.3	3	3.9	2	4.2	1	4.4	3	6.3	5	9.7	13	8.9	19	8.7	15	8.1	14	7.8	9	6.7	8	4.1	3	2.4	2	0	89

FALL

Surface	2.5	6	1.9	6	2.1	6	2.1	7	2.3	8	2.1	5	1.2	6	1.7	4	3.5	5	4.6	4	4.0	6	2.9	5	3.5	6	3.0	7	2.9	4	2.4	3	12	99
2,000 m.s.l.	3.6	6	4.1	5	2.4	4	3.3	4	2.4	6	3.0	7	3.3	10	2.9	6	3.2	8	4.3	5	2.9	6	7.8	7	5.7	7	4.4	7	4.9	6	3.9	5	1	97
3,000 m.s.l.	6.6	3	6.3	3	6.4	5	7.2	5	6.5	5	6.7	5	3.9	4	4.4	4	5.1	5	6.0	9	6.9	11	8.4	15	7.8	10	8.2	7	5.5	5	4.3	4	0	94
4,000 m.s.l.	4.8	5	7.7	5	7.7	4	4.9	3	3.7	2	6.2	3	3.6	3	5.2	3	6.6	4	9.7	9	8.5	14	7.4	12	10.0	10	9.5	10	7.5	8	9.4	5	0	82

Avrage wind directions and velocities at 3:00 a.m., summer months, 1931–32. (a) all winds, (b) winds followed within 24 hours by thunder storms

	Surface 1,346 m.s.l.				2,000 m.s.l.				3,000 m.s.l.				4,000 m.s.l.			
	(a) Summer months		(b) Preceding thunder storms		(a) Summer months		(b) Preceding thunder storms		(a) Summer months		(b) Preceding thunder storms		(a) Summer months		(b) Preceding thunder storms	
	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.	Percent	M.p.s.
N	2	2.2			12	2.5	14	2.7	2	6.5	9	5.0	2	7.7		
NNE	1	2.5			4	2.7			2	6.0	5	9.0	1	2.0	4	4.0
NE	3	1.6	4	1.0	5	1.9			3	3.8	4	4.0	1	4.0	4	4.0
ENE	1	1.0			3	3.2	4	4.0	2	4.8	5	3.0	3	3.2	5	2.0
E	2	1.0			3	2.2			5	4.1	9	6.5	2	9.7	9	10.5
ESE	1	1.5			1	4.0	5	5.0	5	5.2	5	7.0	2	9.5		
SE	2	1.5			6	3.2	9	3.0	6	4.3	18	3.5	3	4.3	9	4.5
SSE	6	1.3	14	1.3	7	2.8	5	1.0	5	5.4	5	3.0	11	8.1	9	4.5
S	11	1.3	9	1.0	4	3.9	5	3.0	9	6.4	14	1.0	13	9.0	9	6.0
SSW	6	1.3	14	1.3	4	4.6	4	2.0	15	7.8	5	4.0	23	9.1	23	4.4
SW	8	1.4	9	2.5	2	3.2	4	1.0	22	7.2	4	5.0	15	10.0	9	7.5
WSW	4	1.8	5	2.0	2	2.5			12	7.6			9	7.4	5	4.0
W	5	1.4	4	3.0	3	4.6	4	4.0	5	5.8	4	3.0	6	8.5	5	6.0
WNW	4	2.5			9	4.3	5	5.0	3	6.2	9	3.5	6	8.3	9	4.5
NW	1	2.0			14	4.2	18	4.5	2	4.7	4	3.5	1	9.5		
NNW	1	2.5			18	3.9	2.3	4.6	2	4.8			2	5.3		
Calms	42		41		3		0		0		0		0		0	
Average m.p.s.		1.7		1.7		3.4		3.3		5.7		4.4		7.2		5.2

Average wind velocities for all directions, March 1, 1931, to March 1, 1933

	Velocities in m.p.s.							
	Surface 1,346 m.s.l.				3,000 m.s.l.			
	3:00 a.	9:00 a.	3:00 p.	9:00 p.	3:00 a.	9:00 a.	3:00 p.	9:00 p.
January	1.4	1.6	3.2	2.5	11.8	12.6	12.4	11.2
February	1.4	1.4	2.6	1.9	10.9	10.4	9.8	11.0
March	1.3	1.2	4.3	2.6	9.2	9.0	7.2	8.2
April	1.2	1.4	4.8	2.8	8.2	8.2	6.8	7.6
May	1.4	2.0	4.6	2.5	6.2	6.0	5.4	6.5
June	.9	1.6	4.8	3.9	5.9	6.3	5.2	6.1
July	.8	1.4	4.8	2.8	6.8	6.4	6.0	6.4
August	.8	1.2	4.8	2.2	6.2	6.3	4.6	6.1
September	1.0	1.2	3.4	2.1	5.8	5.4	4.6	5.6
October	1.2	1.2	3.4	1.8	8.0	7.6	5.9	6.4
November	1.4	1.2	2.9	1.6	9.9	9.4	9.0	9.8
December	1.5	1.3	2.3	2.2	9.4	9.3	9.2	11.2
Year	1.2	1.4	3.8	2.4	8.2	8.1	7.2	8.0

Average increase in velocity between surface and 3,000 m.s.l.

	3:00 a.	3:00 a.	3:00 p.	9:00 p.
Winter	9.3	9.4	7.8	8.9
Spring	6.6	6.2	1.9	4.8
Summer	5.5	4.9	.5	3.2
Fall	6.7	6.3	3.3	5.5
Year	7.0	6.7	3.4	5.6